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Canada Centre for Mineral and Energy Technology | Centre canadien de la technologie des minéraux et de l'énergie

SUMMARY REPORT OF THE STATUS OF CANADIAN CLM PROJECTS: IEA COAL-LIQUID MIXTURES IMPLEMENTING AGREEMENT ANNEX II BASE TECHNOLOGY

H. Whaley
Combustion and Carbonization Research Laboratory

MAY 1983

Presented at the 2nd Technical Committee Meeting IEA/CLM Implementing Agreement, Annex II CLM Base Technology "Cooperation in the Exchange of Base Technology Information for Coal Liquid Mixtures", Clearwater Beach, Florida April 29, 1983

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ENERGY RESEARCH PROGRAM
ENERGY RESEARCH LABORATORIES
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SUMMARY REPORT OF THE STATUS OF CANADIAN CLM PROJECTS: IEA COAL-LIQUID MIXTURES IMPLEMENTING AGREEMENT ANNEX II BASE TECHNOLOGY MAY 1983

by

Horace Whaley

INTRODUCTION

Objectives of the Canadian CLM Program

The ultimate objective of the Canadian coal-liquid-mixture program is to derive enough data concerning the fuels and how to burn them that potential users will be able to make decisions to replace oil, based on economics and without technical risk. An essential sub-objective is the establishment of a quality-cost-price relationship. Obviously it costs more to prepare a high quality (i.e. low sulphur, low ash) mixture than a low quality one. Research into the application of oil agglomeration to coal-oil-water mixtures has indicated the costs in terms of light oil addition for various levels of rejection of mineral matter including sulphur. Depending on the fineness of grind and mineral content needed, light oil requirements may vary from 1% to 5% of coal weight. For coal-water mixtures, conventional cleaning applied to the highest quality coal can reduce mineral matter to 3% and sulphur to 1.2%: grinding and multistage flotation can reduce these levels to 1.5% and 0.8% respectively: if lower quality (less expensive) coals are used, the same process is expected to attain about 3% minerals and 1.5% sulphur, the cost difference being in the starting feedstock coal rather than in the process.

Use of coal-liquid mixtures by utilities requires a delivery and storage system, including stirring vessels where necessary, and pumps which can deal with fluctuations in diurnal and seasonal demand. The program is

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demonstrating methods of transportation which will be applicable to industrial users and, later this year, some of the combustion tests will be scheduled in freezing weather so that any problems due to low temperature operations can be detected and solved. Addition of anti-freeze such as methanol may be necessary, this will add to the cost but may improve combustion characteristics.

The performance of utility boilers designed for oil will be significantly different when using coal-water mixtures. The problem of unit derating has already been mentioned and each unit to be converted will need a detailed individual assessment to ascertain its loss in electrical generating capacity when firing a typical coal-water mixture. Again, the derating will depend strongly on the fuel and the boiler design. One of the objectives of the current program is to provide data for the determination of the inter-relationship between properties and quantity of mineral matter in the coal-water fuel, the flame and unit derating. The utility company will then determine the net loss in its system generating capacity if several units are to be converted to coal-water fuel. It must by noted that a significant requirement of the coal-water mixture program is that the slurry burners be compatible with the retention of fuel oil capability to attain full generating capacity during peak demand periods.

Assuming successful demonstrations at Chatham, the next steps proposed are to conduct tests in oil-designed boilers of similar size to the larger Chatham boiler and then to design systems for burning coal-water fuel in larger utility units. In eastern Canada there are several larger front-wall and tangentially-fired oil-designed units. The current program embraces the design of coal-water systems for both configurations.

The present program comprises several projects which will combine to achieve the objectives set out above. These are construction of a 7 tonne/h pilot plant at Sydney, Nova Scotia, for preparation of a coal-water mixture containing over 70% coal, the design of burners suitable for reliable combustion of this fuel; the demonstration of the use of CWM and the necessary support technology to these two main projects form the basis for the Canadian contributions to the IEA Annex II program of work. The design of coal-water supply and burner systems for larger units is an obvious extension of these projects.

RAPPORT SOMMAIRE SUR LA SITUATION DES PROJETS MCP (MÉLANGES CHARBON-PÉTROLE): ENTENTE AVEC L'AIÉ SUR LES MÉLANGES CHARBON-PÉTROLE ANNEXE II - TECHNOLOGIE DE BASE MAI 1983

par

Horace Whaley*

INTRODUCTION

Objectifs du programme canadien sur les MCP

L'objectif ultime du programme canadien sur les MCP consiste à recueillir suffisamment de données au sujet des combustibles et des techniques utilisées pour les brûler afin que les utilisateurs éventuels soient en mesure de prendre des décisions en ce qui concerne les substituts du pétrole fondées sur des études économiques et éliminant les risques techniques. Un des objectifs de deuxième ordre mais tout autant essentiel vise à établir une relation qualité - prix coûtant. Évidemment, il est plus coûteux de préparer un mélange de haute qualité (c'est-à-dire faible en soufre et en cendre) qu'un mélange de basse qualité. Les résultats de recherches effectuées sur l'agglomération de pétrole aux mélanges charbon-pétrole-eau ont indiquée les coûts en fonction de l'addition d'huile légère pour divers niveaux de rejet de substances minérales, incluant le soufre. Les exigences en ce qui concerne la quantité de charbon légère peuvent varier de 1% à 5% du poids de charbon, selon la finesse du grain et le contenu en minéraux nécessaires. Les méthodes de lavage classiques appliquées à la plus haute qualité de charbon peut réduire la présence de substances minérales à 3% et celle du soufre à 1,2% dans les mélanges charbon-eau. Le broyage et la flottation à étape multiple peuvent réduire ces niveaux à 1,5% et 0,8% respectivement. Si on utilise des charbons de moindre qualité (moins coûteux par conséquent), on obtiendra par ces mêmes procédés des niveaux atteignant 3% de minéraux et 1,5% de soufre. Dans ce cas-ci, la différence de coût dépend de la matière première (le charbon) plutôt que du procédé appliqué.

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L'utilisation de mélanges charbon-liquide par des utilisateurs privés demande que l'on implante des systèmes de livraison et d'entreposage, qui comportent des récipients d'agitation si nécessaires et des pompes qui peuvent s'adapter aux fluctuations journalières et saisonnières selon la demande. Le programme fait la démonstration de méthodes de transport applicables à l'industrie privée. Plus tard au courant de l'année, on effectuera des essais de combustion par temps glacial de façon à détecter et à solutionner les problèmes rencontrés dans de telles conditions climatiques. L'addition d'antigel, tel que le méthanol, peut être nécessaire et peut améliorer les propriétés de combustion même si le coût en est ainsi augmenté.

Le rendement des chaudières conçues pour le pétrole sera très différent lorsqu'on utilisera des mélanges charbon-eau. On a déjà fait mention du problème de la dévaluation des unités et il est nécessaire que chaque unité convertie soit évaluée en détail et individuellement en fonction de la perte en puissance de production d'électricité lors de la combustion d'un mélange charbon-eau classique. Encore une fois, la dévaluation dépendera grandement du combustible et de la conception de la chaudière. Un des objectifs du présent programme consiste à fournir des données pour déterminer la relation entre les propriétés du minerai et sa quantité dans le combustible charbon-eau, la flamme et la dévaluation de l'unité. La compagnie déterminera par la suite la perte nette dans son système du puissance de production si plusieurs unités sont converties aux combustibles charbon-eau. Il est important de prendre note qu'une des exigences du programme sur les mélanges charbon-eau est que les brûleurs de bouillie puisse conserver le pétrole afin d'atteindre la puissance maximale de production aux périodes de consommation de pointe.

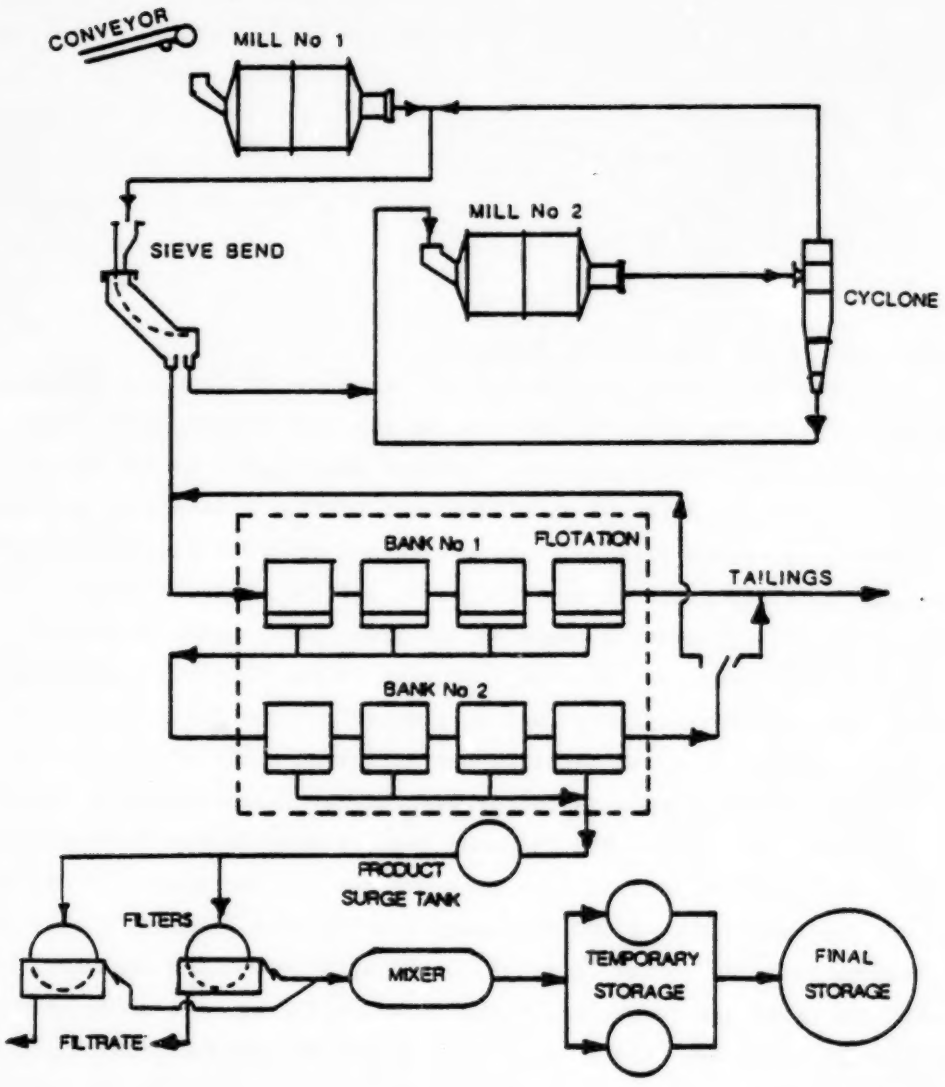
En supposant que la démonstration à Chatham soit couronnée de succés, les étapes suivantes proposées consistent à mettre à l'essai les chaudières conçues spécialement pour le pétrole, de format semblable à celui de la grosse chaudière de Chatham et finalement, à concevoir des systèmes capables de brûler des combustibles charbon-eau dans des unités plus grosses. Dans l'est du Canada, il existe plusieurs unités conçues pour utiliser du pétrole dont les brûleurs sont montés sur un seul des murs ou sur les quatre murs de la chaudière. Le présent programme comprend la conception de systèmes pour les combustibles charbon-eau selon des deux modèles d'unités.

Le programme comprend aussi plusieurs projets qui s'entrecroisent pour atteindre les objectifs mentionnés auparavant. Un de ces projets consiste à construire une usine pilote de 7 tonnes par heure à Sydney en

Nouvelle-Écosse, pour la préparation d'un mélange charbon-eau contenant plus de 70% de charbon, et à concevoir des brûleurs qui conviennent à la combustion efficace de ce combustible. La démonstration de l'utilisation des mélanges charbon-eau et l'apport technologique de soutien nécessaire à ces deux projets constituent la base du programme de travail sur les contributions canadiennes à l'AIÉ - Annexe II. La conception de mélanges charbon-eau et de systèmes de brûleur pour des unités plus grosses constitue un volet complémentaire à ces projets.

Project No. 1: CWM Preparation Plant

The CWM prepartion pilot-plant using the AB Carbogel (Sweden) process treats clean coal (-3 mm) from an adjacent conventional dense medium coal preparation plant which reduces the mineral matter content from about 8% to 3%. The pilot plant illustrated in Fig. 1 comprises two stages of grinding, particle size control, two stages of froth flotation (further reducing the mineral matter to about 1.5%) and the mixer to add a stabilizer. The process is based on the proprietary CARBOGEL process. The target solids content is 75% with viscosity in the 800-1000 centipoise range. Use of higher quality coal is planned for the first trials to minimize problems with ash handling but different coals with higher mineral and sulphur contents and with poorer washability characteristics could save $20 per tonne (of coal). The prepared fuel is held in day-storage tanks for regular delivery by rail (one tank car per day for about 750 km) to Chatham: storage tanks of 500 m^3 capacity which were already in existence at Chatham form the buffer to match demand with production capacity. Fuel production costs are recovered by the producer through the price charged to the electric utility. The utility then passes on the differential between this price and normal coal-fired enerating costs, as well as the cost of burner development, to the federal government. Construction of the pilot plant began in November 1982 and should be completed by early June 1983 with regular fuel production by late June 1983. (See the Project Manager's Reports attached).



NOTE: Feed piping from the flotation unit is now to be split to feed both units simultaneously, the plant capacity is then increased by about 75%, for the relatively modest cost of a second vacuum filter.

Fig. 1 - Schematic illustration of CWM preparation plant flow sheet

Project No. 2: Development of CWM Burners for Front-Wall and Tangentially Fired Boilers at Chatham, New Brunswick

Development of CWM burners for the units at Chatham is being undertaken concurrently with the construction of the coal-water pilot-plant preparation facility. The two phases of burner development are as follows:

Phase I

The design, testing and evaluation of burners, rated at approximately 30 GJ/h thermal input, suitable for coal-water slurry fuel combustion in the 10 MW(e) front-wall fired unit. An evaluation program for burner and boiler performance assessment was developed for the performance trials which are to be undertaken in this unit during Phase II. A parallel program to develop 60 GJ/h burners for the tangentially fired configuration is leading to performance trials in the 22 MW(e) unit.

Key elements of Phase I are a review of the state of the art of coal-liquid mixture burner technology and recommendation of the most promising burner concepts for coal-water mixture firing for each boiler configuration. Full scale burners have been designed and were tested prior to installation in the units at Chatham.

The present progress on the burner development aspects of the program are as follows:

Foster Wheeler Canada subcontracted the development of burners for Unit 1 to their subsidiary Forney Engineering of Dallas. A quantity of design fuel was shipped to Forney and a test burn of the fuel was conducted in December 1982. After this test work, manufacture of the four burners commenced and these are now on site at Chatham, ready for installation on the unit.

Modifications to the boiler have been finalized and are presently under construction. This includes a minor modification to the burner front duct work, the complete removal of the existing burners along with some refractory quarl, replacement of pressure tubes and installation of the four new burners.

The program schedule for Unit No. 1 calls for a baseline oil performance test in late June and then firing of the design CWM in early July with appropriate performance testing.

CE Canada has subcontracted the burner development for Unit No. 2 to Keisinger Development Laboratories (KDL) their research facility in Windsor, Connecticut. A quantity of the design fuel has been supplied to KDL and atomizer spray tests have been conducted and evaluated. Several burner designs have been reviewed with the management committee and preparations are now under way to conduct combustion tests of the final design in the test facility.

Modifications to the No. 2 Unit are in the detailed design stage and some of the equipment is being procured and shipped to Chatham. The expected test burn program on Unit No. 2 is expected to begin by about mid-August 1983. (See Project Manager's Report attached).

Project No. 3: Coal-Water Mixture Derating Assessment of Oil-Designed Utility Boiler

The specific objectives of this project were to assess the probable derating of oil-designed utility boilers of 60 and 200 MW(e) and of four typical Canadian designs when firing CWM's at varying boiler loads. The CWM's to be studied were designated commercial fuel, and are higher in ash (3% and 9%) than the design fuel used for Project Nos. 1 and 2. It is expected that this range of ash level variation will give some information on the costs of coal cleaning versus flue gas clean-up as well as on the derating aspects of the project.

The present status of this project is that the work on the two front-wall fired confirgurations has been completed and a draft report prepared by Babcock and Wilcox Canada and reviewed by CANMET. A copy of the final report will be circulated to Annex II participating countries in the near future. The draft report on the derating of tangentially-fired boilers is expected at the end of June and the final report will be circulated when received.

Project No. 4: Fluidized-Bed Combustion of Coal-Water Mixtures

Coal cleaning operations produce large quantities of combustible tailings containing large fraction of ash and moisture. These tailings pose a difficult disposal problem. It is the intention of Energy, Mines and Resources Canada to explore the feasibility of incinerating such slurries in a fluidized-bed combustor as an alternate means of disposal. Concurrently, EMR wishes to explore fluidized-bed combustion techniques as an alternative to conventional combustion for higher quality CWM. This avoids the problems of atomizer wear and to some extent the need for low ash and sulphur fuels.

Babcock and Wilcox Canada Ltd is the designated contractor and will carry out parameteric fluidized-bed combustion studies with a 1 ft x 1 ft pilot FBC at B & W Alliance Research Center. Three slurry fuels, including thickener underflow from a western Canadian coal preparation plant; beneficiated and unbeneficiated eastern Canadian coal prepared by the Carbogel process, will be tested to investigate whether stable, efficient combustion can be achieved in a fluidized-bed combustor. The test program will consist of optimum input conditions determination; measurement of combustion efficiency, measurement of pollutant emissions and, with the high-sulphur feedstocks determination of the efficiency of sulphur capture with limestone.

Fuel shipments are being deliverd to B & W Alliance Research Center. The chemical analysis of one of the feedstock was completed. The pilot test program will be started in May and the final report should be available by November 1983.

Project No. 5: Spherical Agglomeration applied to CLM's

Objectives: Recovery and beneficiation of waste fine coals by oil agglomeration followed by utilization in CLM's. Use of spherical agglomeration to produce cleaner CLM's by rejection of impurities liberated during size reduction for CLM preparation.

Organization: Chemical Engineering Section, Division of Chemistry, National Research Council, Ottawa, Canada K1A 0R9

Project Manager: C. E. Capes, at above address.
K. F. Burrill, Scotia Liquicoal Ltd
Halifax, Nova Scotia

Recent Progress: (April 1983)

1. Commissioned mobile pilot fine coal recovery plant in Autumn 1982.
2. Demonstrated agglomeration and screening of waste pile of Princess Wash Plant of the Cape Breton Development Corporation in late 1982 at 1 t/h rate in mobile pilot plant. Prepared report and commercial plant design (both confidential at the present time) on the recovery and beneficiation of this material.
3. Laboratory work is in progress, to be followed by tests in demonstration plant, to regrind such waste coals for use in CLM's of low impurity content. This work includes tests of the formulation of CWM formed from oil-agglomeration-recovered coals in which a trace of oil must necessarily remain.

C. E. Capes
83 04 19

Project No. 6: Development of CLM Burner Tip and Assembly

Objective: Development of an erosion-resistant burner tip and compatible burner assembly for CLM combustion.

Organization: Atlantic Research Laboratory, Halifax, Nova Scotia and Division of Chemistry, National Research Council, Ottawa, Canada K1A 0R9

Project Manager: S. G. Whiteway (ARL) and W. L. Thayer (NRC-Chem)

Recent Progress (April 1983)

1. Hot spray recirculation tests and preliminary combustion trials had verified the atomizer of annular design with ceramic inserts is well suited for wear resistance to the erosive nature of CLM fuels.
2. Further combustion tests in Technical University of Nova Scotia flame tunnel in March, 1983 established a compatible burner assembly for the atomizer using COWM fuel, as well as CWM fuel over a short test of several hours.
3. Longer term combustion testing for burner assembly now being planned to take place in the coming months.

Project No. 7: Coal-Liquid Mixture Combustion Parameters

The specific objectives of this program are to determine basic combustion parameters for commercial CLM's as they become available in Canada. The specific test program will be as follows:

1. To determine the aerodynamic requirements for a stable CLM flame;
2. To evaluate the flame and heat transfer characteristics of the CLM's under controlled aerodynamic and combustion conditions;
3. To assess the gaseous and particulate emissions produced during the tests; and
4. To compare the performance of the CLM with No. 6 fuel oil.

The program will be carried out in the CCRL pilot-scale tunnel furnace, maximum thermal input 3 GJ/h and compromised of 28 individual calorimetric sections. Residence time and flame stability can be varied by the addition of an adiabatic pre-ignition section, if necessary. The burner to be used will be that developed by NRC (Project No. 6). The first such fuels to be studied will be a typical Scotia Liquicoal product (COW) and a Carbogel CWM (design fuel) from the coal/water utility development program in the Maritimes. (See Projects No. 1 and 2).

Preparatory work on the furnace and burner assembly is being conducted during the May/June 1983 period and the slurries are on site at the CANMET Bells Corners Complex - CCRL. It is expected the test program will take place during July 1983.

H. Whaley
83 05 27

File 3-422B
Chatham Coal Water
Burner Development

PROGRESS REPORT #9

The New Brunswick Electric Power Commission
Coal Water Burner Development
February 28, 1983

1.0 SUMMARY

The Steering Committee met with C.E. Canada to review nozzle alternatives and fuel handling problems.

2.0 PILOT PLANT

The following items were undertaken during February:

2.1 Float cell foundations completed.

2.2 Interior facility 60% completed.

2.3 Tenders have been received for the electrical installation and the requisition is prepared to place the contract.

2.4 The skip loader has been received and placed in service.

2.5 Viscosity control tanks have been ordered.

2.6 Two operating staff have started work.

3.0 Fuel

Fuel Transportation

Three methods of transportation are being investigated along with shipping schedules, production rates, burn rates and the equipment required. These methods are tank truck, rail and barge.

4.0 Chatham Plant

Finalized detailed design for modification to one bunker - material on order.

Boiler #1 (the front fired unit) was inspected by the boiler service representative.

Reviewing test perimeters for the test burn.

5.0 Burner Development

5.1 C.E. Canada Contract

The Steering Committee met with C.E. Canada and KDL, February 11, 1983 to review atomizer designs, atomizing air requirements and potential fuel problems.

Specific direction was given to C.E. Canada in order that work might continue with minimum delay.

5.2 Foster Wheeler Limited Contract

Burner design is continuing with further investigation into alternative materials for the nozzels.

F.W. Service representative inspected the #1 Chatham boiler.

6.0 Committee and Meeting

6.1 Steering Committee

The Steering Committee met in Halifax, N.S. February 2, 1983 and in Ottawa with C.E. Canada, February 11, 1983.

6.2 Technical Committee

No meetings scheduled.

6.3 Project Meetings

Pilot Plant, Sydney, N.S.

A pilot plant project review meeting was held February 3, 1983 in Sydney at the site. Regular weekly meetings were also held by CBDC.

Chatham Plant, Chatham, N.B.

A burner development project review meeting was held in Chatham at the plant, February 9, 1983; and several internal meetings on specific topics.

7.0 Schedule

The project is on schedule.

D.M. Rankin
Project Manager

File 3-422B
Chatham Coal Water
Burner Development
Progress Report

PROGRESS REPORT #10

The New Brunswick Electric Power Commission
Coal Water Burner Development
March 31, 1983

1.0 SUMMARY

Initial problems with construction staffing at Chatham on the fuel storage facility have been overcome and work is proceeding.

Equipment has started to arrive at the pilot plant.

2.0 PILOT PLANT

The following items were undertaken during March:

2.1 50% of the float cells have been received, welded together and grouted in place.

2.2 Feed conveyor foundation has been completed. Conveyor and hopper have been installed.

2.3 Anchor bolts have been installed for the ball mills.

2.4 The electrical for the offices and building has been roughed in.

2.5 Grating has been installed on the floor trenches.

2.6 One 25,000 gallon tank has been received.

2.7 Two Carbogel personnel were on site to review the process.

3.0 Fuel

The transportation study has been completed.

4.0 Chatham Plant

The initial delays in obtaining temporary special skills has been overcome; material is on site and work on the modification to the bunker is proceeding rapidly.

A draft test program for unit no. 1 has been reviewed.

5.0 Burner Development

5.1 C.E. Canada Contract

The test burn at KDL has been postponed so that the actual nozzles which will be used in Chatham can be tested in the flame tunnel. This is not expected to delay the test burn on Unit #2.

5.2 Foster Wheeler Limited Contract

Burner design has been completed. Work is proceeding on nozzle material selection. Boiler modification drawings have been completed. The draft test program has been reviewed.

6.0 Committee and Meeting

6.1 Steering Committee

No meetings.

6.2 Technical Committee

No meeting.

6.3 Project Meetings

Pilot Plant, Sydney, N.S.

March 3 : General pilot plant project meeting was held at Sydney.

March 15 : A meeting was held to review the pilot plant with two Carbogel represenatives.

Weekly meetings were also held.

Chatham Plant, Chatham, N.B.

Burner development project review meeting was held at Chatham on March 8 and March 29.

Several special meetings were held on specific topics.

7.0 Schedule

The project is on schedule.

D.M. Rankin
Project Manager

File 3-422B
Chatham Coal Water
Burner Development
Progress Report

PROGRESS REPORT #11

The New Brunswick Electric Power Commission
Coal Water Burner Development
April 30, 1983

1.0 SUMMARY

Work at the Pilot Plant and Chatham No. 1 Unit on schedule.

2.0 PILOT PLANT

The following items were undertaken during April:

2.1 The float cells have been received, welded together and grouted in place.

2.2 Cat walks and trim on float cells being installed.

2.3 Concrete pads installed for the vescosity control tanks.

2.4 Installation of pumps & piping in progress.

2.5 Well test completed.

2.6 Seven people on staff now.

3.0 Fuel

The transportation study has been completed. Tenders for the movement of fuel from Sydney to Chatham are being invited.

4.0 Chatham Plant

Modifications to the No. 1 boiler are proceeding rapidly. New tubes have been obtained and are being installed. New burners have arrived.

A draft test program for unit no. 1 has been prepared and is being finalized.

5.0 Burner Development

5.1 C.E. Canada Contract

The test burn at KDL has been postponed.

5.2 Foster Wheeler Limited Contract

Burner design has been completed. Work is proceeding on nozzle material selection. Boiler modification new tubes are being installed. Burners have been delivered to the plant.

6.0 Committee and Meeting

6.1 Steering Committee

No meetings.

6.2 Technical Committee

No meeting.

6.3 Project Meetings

Pilot Plant, Sydney, N.S.

April 13 : General review of the pilot plant progress.

Weekly meetings were also held.

Chatham Plant, Chatham, N.B.

Burner development project review meeting was held at Chatham on April 15.

Several special meetings were held on specific topics.

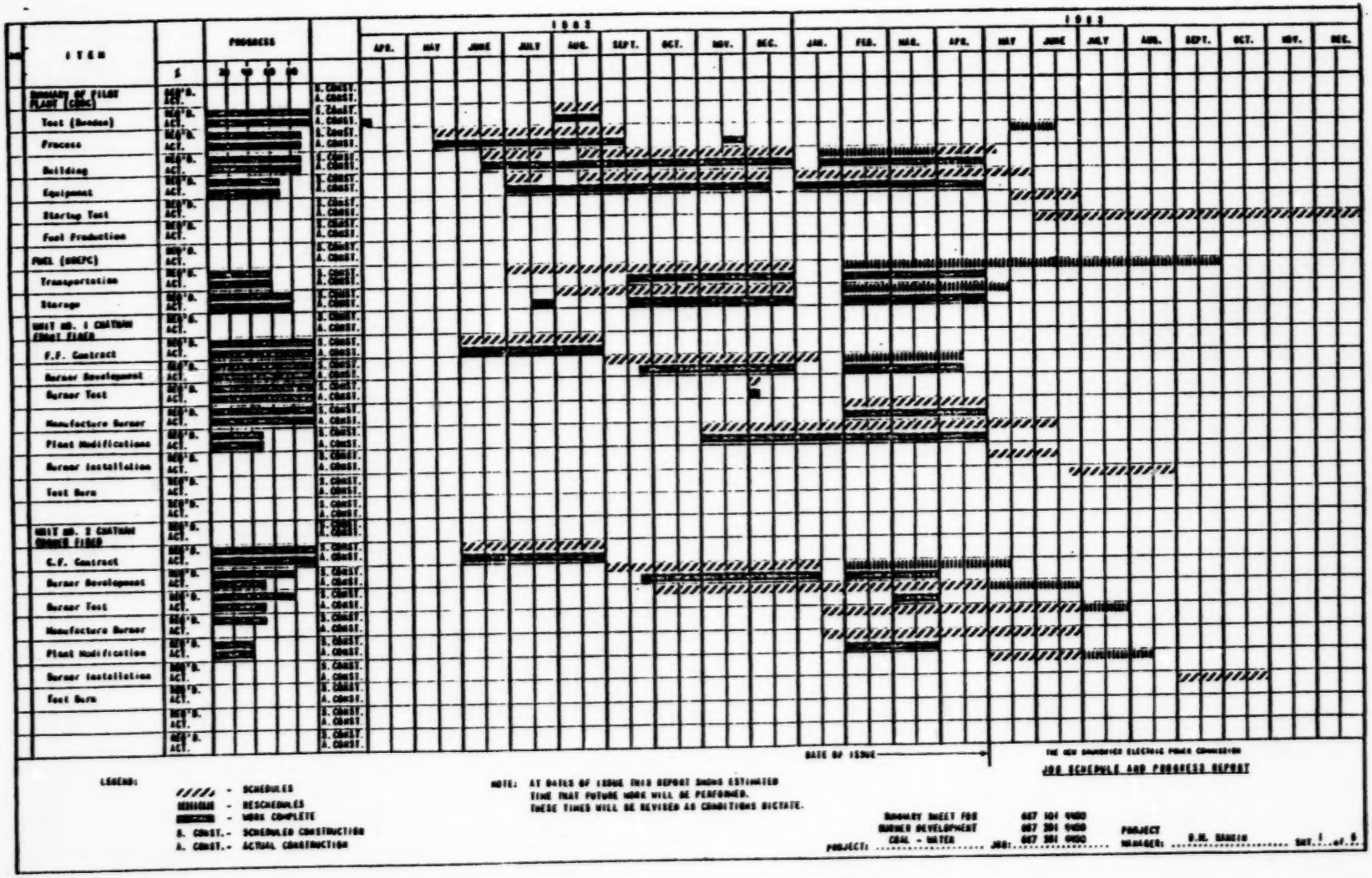
7.0 Schedule

The project is on schedule.

8.0 International Semposium on Coal Slurry Combustion and Technology - Tampa - a paper was presented.

8.1 E.P.R.I. test burn coal water slurry at Dupont, Memphis - a meeting was held April 28 to review procedures. The test is scheduled for August 1983.

D.M. Rankin
Project Manager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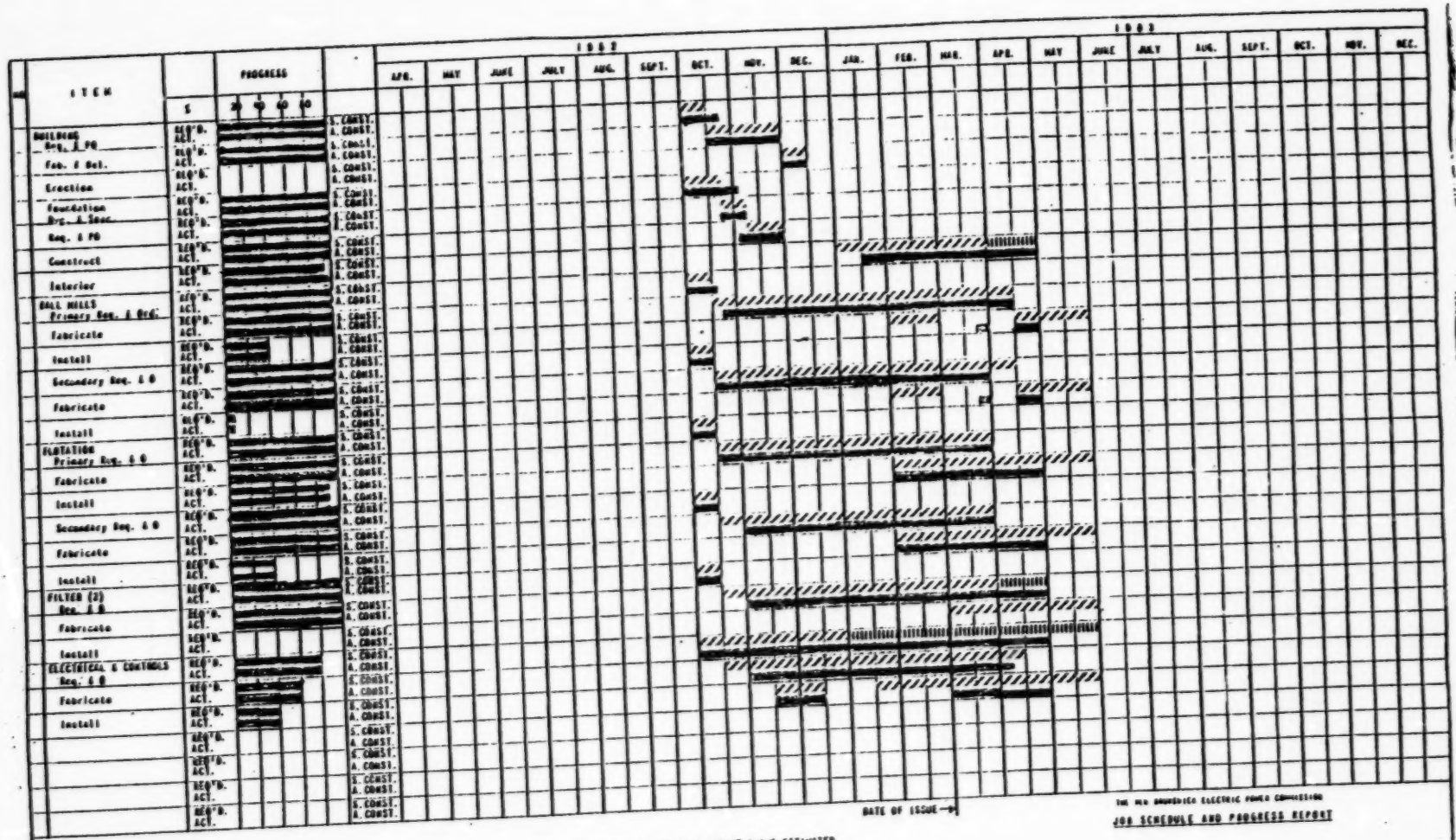
ITEM
PROGRESS
SUMMARY OF PILOT PLANT (CDEC)
Test (Random)
Process
Building
Equipment
Starting Test
Fuel Production
FUEL (OHEPC)
Transportation
Storage
UNIT NO. 1 CHATHAM COAL FIRED
F.F. Contract
Burner Development
Burner Test
Manufacture Burner
Plant Modifications
Burner Installation
Test Burn
UNIT NO. 2 CHATHAM COAL FIRED
F.F. Contract
Burner Development
Burner Test
Manufacture Burner
Plant Modification
Burner Installation
Test Burn
S. CONST.
A. CONST.
DATE OF ISSUE
LEGEND:
- SCHEDULES
- RESCHEDULES
- WORK COMPLETE
S. CONST.- SCHEDULED CONSTRUCTION
A. CONST.- ACTUAL CONSTRUCTION
NOTE: AT DATES OF ISSUE THIS REPORT SHOWS ESTIMATED TIME THAT FUTURE WORK WILL BE PERFORMED. THESE TIMES WILL BE REVISED AS CONDITIONS DICTATE.
THE NEW HAMPSHIRE ELECTRIC POWER CORPORATION
JOB SCHEDULE AND PROGRESS REPORT
SUMMARY SHEET FOR 667 101 9400
BURNER DEVELOPMENT 667 201 9400 PROJECT
COAL - WATER 667 201 9400 MANAGER: O.H. BAKER SHT. 1 of 8
PROJECT: JOB: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1963
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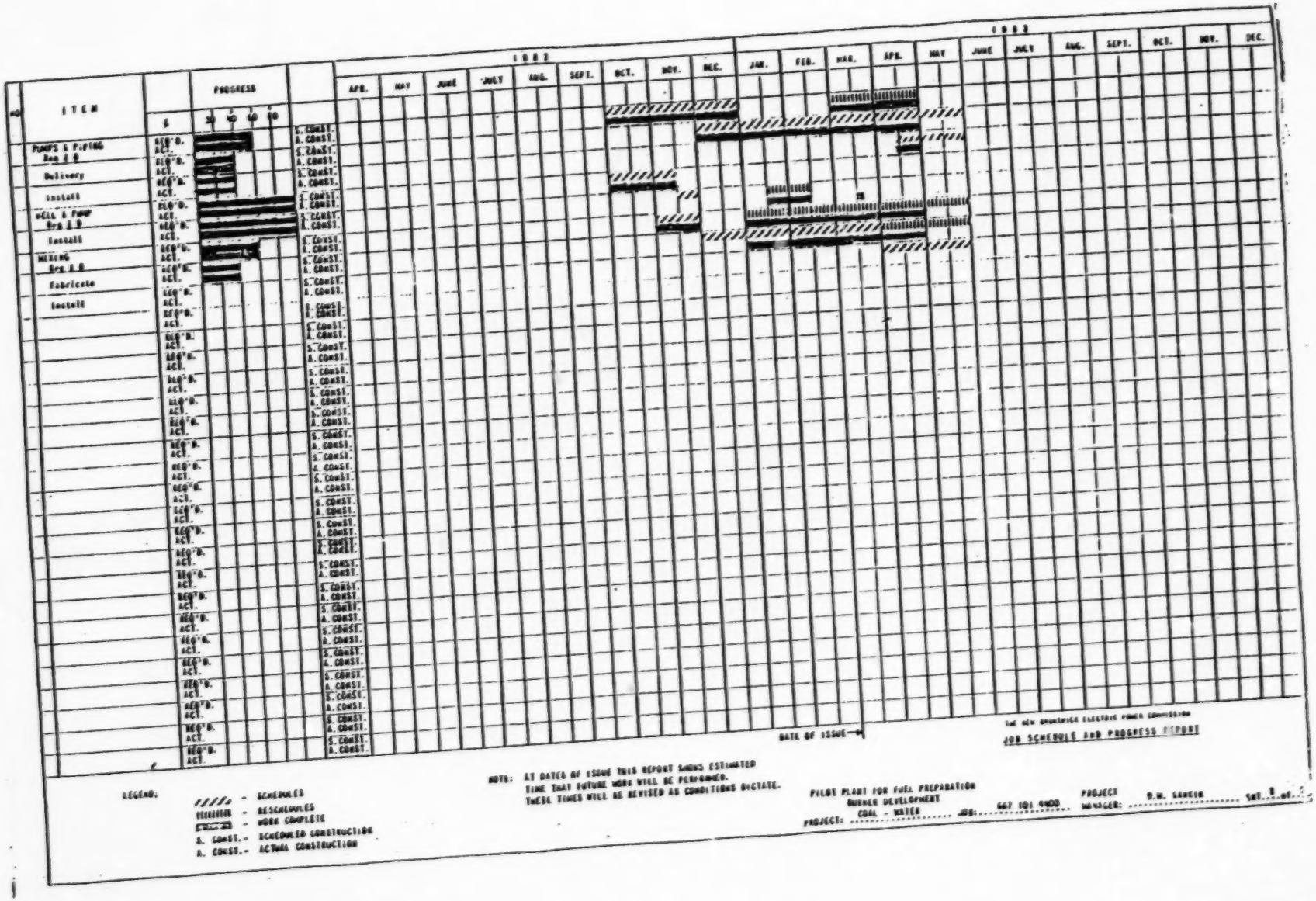
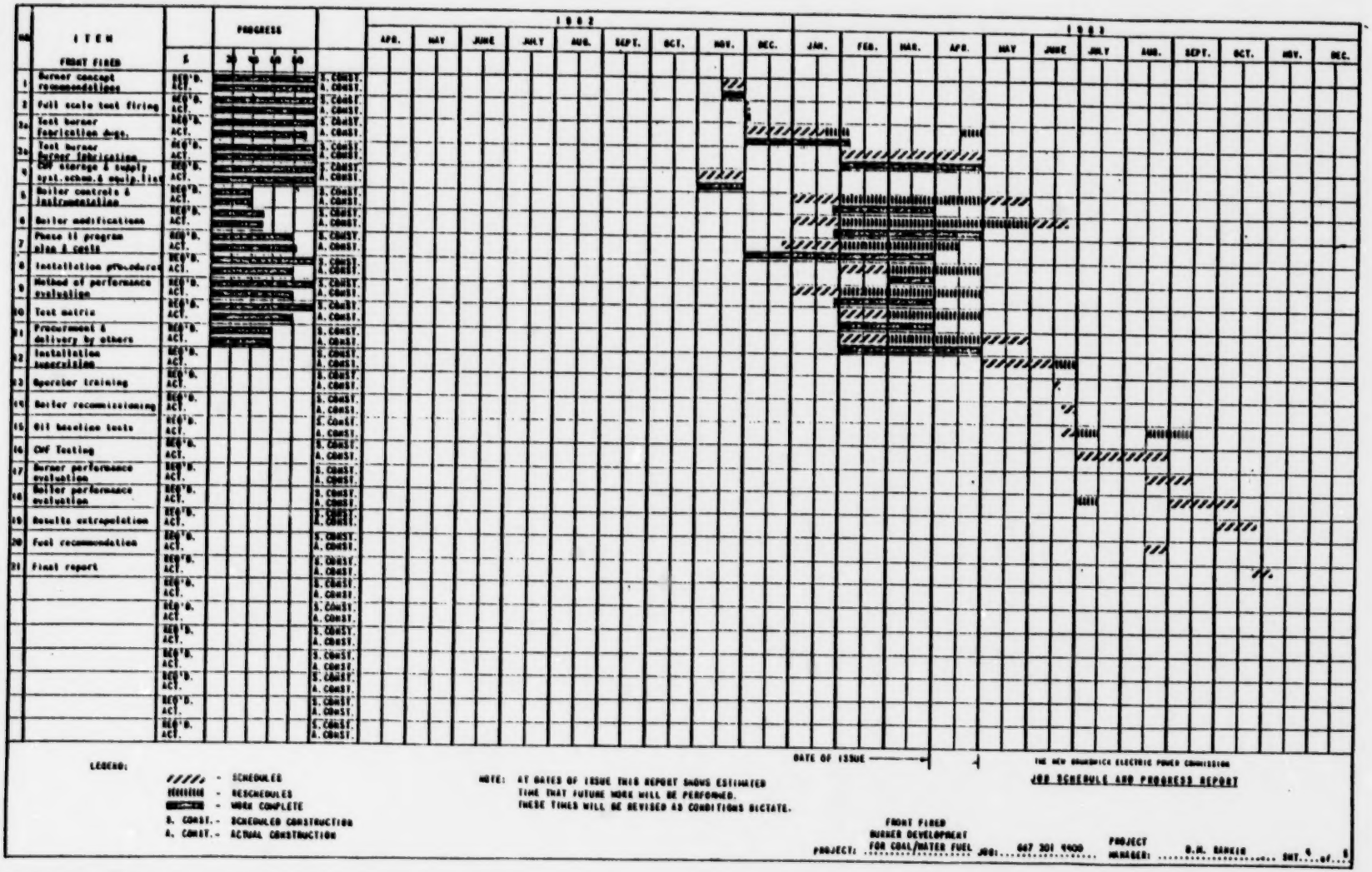
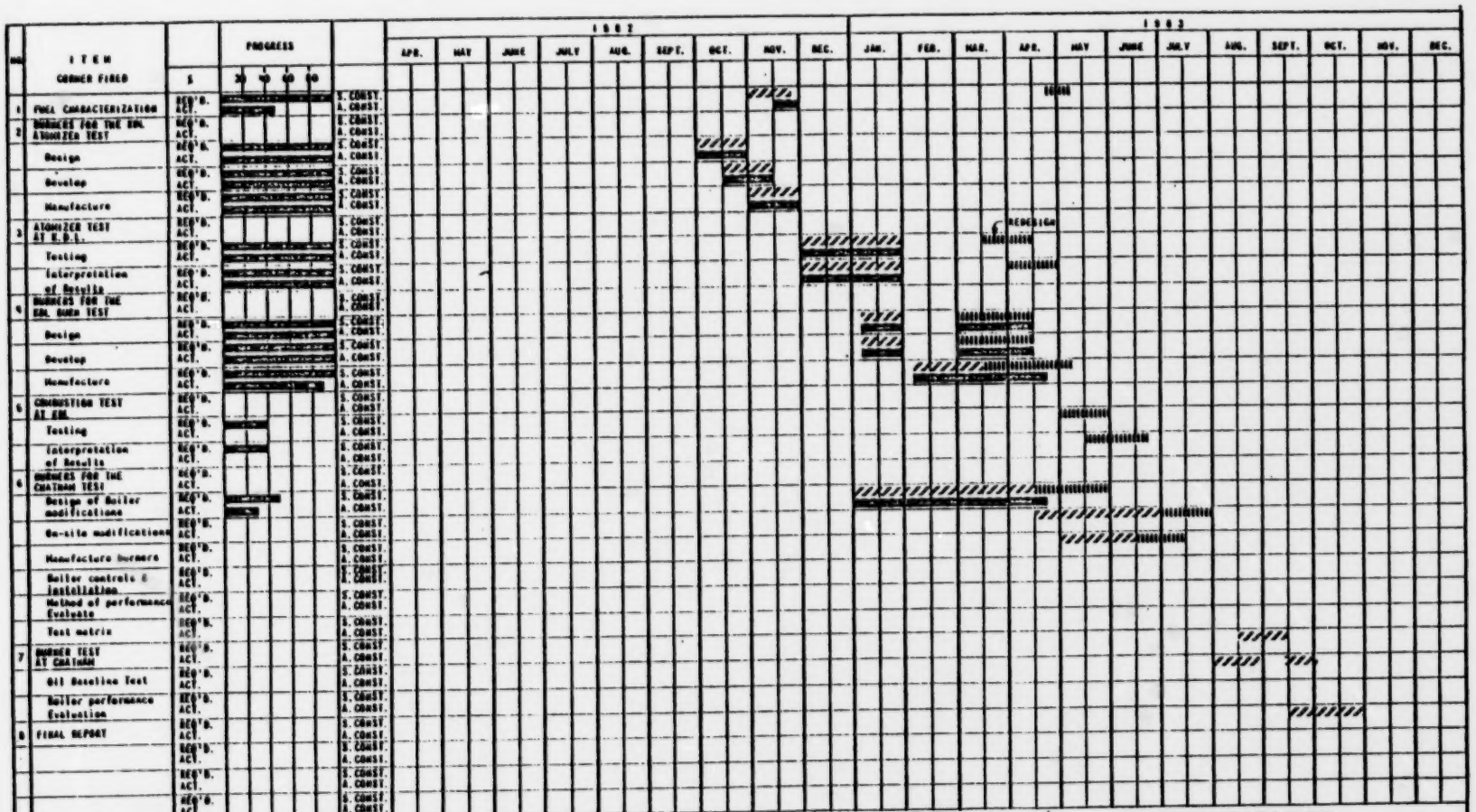
ITEM
PROGRESS
BALL MILLS
FLOTATION
FILTER (2)
ELECTRICAL & CONTROLS
DATE OF ISSUE
THE NEW BRUNSWICK ELECTRIC POWER COMMISSION
JOB SCHEDULE AND PROGRESS REPORT
LEGEND:-
SCHEDULES
RESCHEDULES
WORK COMPLETE
S. CONST.- SCHEDULED CONSTRUCTION
A. CONST.- ACTUAL CONSTRUCTION
NOTE: AT DATES OF ISSUE THIS REPORT SHOWS ESTIMATED TIME THAT FUTURE WORK WILL BE PERFORMED. THESE TIMES WILL BE REVISED AS CONDITIONS DICTATE.
PILOT PLANT FOR FUEL PREPARATION
BURNER DEVELOPMENT
COAL - WATER
PROJECT MANAGER: D.H. BAKER


1962
1963
APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC. JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.
ITEM
$
PROGRESS
0 20 40 60 80 100
PUMPS & PIPING
Req'd.
Act.
Delivery
Install
WELL & PUMP
Eqs & B
Install
MIXING
Eqs & B
Fabricate
Install
S. CONST.
A. CONST.
DATE OF ISSUE
THE NEW BRUNSWICK ELECTRIC POWER COMMISSION
JOB SCHEDULE AND PROGRESS REPORT
LEGEND.
////// - SCHEDULES
\\\\\\ - RESCHEDULES
WORK COMPLETE
S. CONST. - SCHEDULED CONSTRUCTION
A. CONST. - ACTUAL CONSTRUCTION
NOTE: AT DATES OF ISSUE THIS REPORT SHOWS ESTIMATED TIME THAT FUTURE WORK WILL BE PERFORMED. THESE TIMES WILL BE REVISED AS CONDITIONS DICTATE.
PILOT PLANT FOR FUEL PREPARATION
BURNER DEVELOPMENT
COAL - WATER
PROJECT:
667 101 9400
JOB:
PROJECT MANAGER:
D.W. LEWIN
SHT. 1 of 1


1982
1983
APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC. JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.
ITEM
FRONT FIRED
PROGRESS
$
S. CONST.
A. CONST.
1 Burner concept recommendations
2 Full scale test firing
3a Test burner fabrication drgs.
3b Test burner burner fabrication
4 CWF storage & supply syst. schem. & equip. list
5 Boiler controls & instrumentation
6 Boiler modifications
7 Phase II program plan & costs
8 Installation procedures
9 Method of performance evaluation
10 Test matrix
11 Procurment & delivery by others
12 Installation supervision
13 Operator training
14 Boiler recommissioning
15 Oil baseline tests
16 CWF Testing
17 Burner performance evaluation
18 Boiler performance evaluation
19 Results extrapolation
20 Fuel recommendation
21 Final report
DATE OF ISSUE
THE NEW BRUNSWICK ELECTRIC POWER COMMISSION
JOB SCHEDULE AND PROGRESS REPORT
LEGEND:
SCHEDULED
RESCHEDULED
WORK COMPLETE
S. CONST. - SCHEDULED CONSTRUCTION
A. CONST. - ACTUAL CONSTRUCTION
NOTE: AT DATES OF ISSUE THIS REPORT SHOWS ESTIMATED TIME THAT FUTURE WORK WILL BE PERFORMED. THESE TIMES WILL BE REVISED AS CONDITIONS DICTATE.
FRONT FIRED BURNER DEVELOPMENT FOR COAL/WATER FUEL
PROJECT:
JOB: 667 301 9400
PROJECT MANAGER: D.H. BARKER
SHT. 9 OF 9


1962
1963
APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.
JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.
ITEM
CORNER FIRED
PROGRESS
$
25 50 75 100
REQ'D.
ACT.
S. CONST.
A. CONST.
1 FUEL CHARACTERIZATION
2 BURNERS FOR THE ESL ATOMIZER TEST
Design
Develop
Manufacture
3 ATOMIZER TEST AT N.R.C.L.
Testing
Interpretation of Results
4 BURNERS FOR THE ESL GUN TEST
Design
Develop
Manufacture
5 COMBUSTION TEST AT ESL
Testing
Interpretation of Results
6 BURNERS FOR THE CHATHAM TEST
Design of Boiler modifications
On-site modifications
Manufacture burners
Boiler controls & installation
Method of performance Evaluate
Test matrix
7 BURNER TEST AT CHATHAM
Oil Baseline Test
Boiler performance Evaluation
8 FINAL REPORT
REDESIGN
DATE OF ISSUE
THE NEW BRUNSWICK ELECTRIC POWER COMMISSION
JOB SCHEDULE AND PROGRESS REPORT
LEGEND:
SCHEDULES
RESCHEDULES
WORK COMPLETE
S. CONST. - SCHEDULED CONSTRUCTION
A. CONST. - ACTUAL CONSTRUCTION
NOTE: AT DATES OF ISSUE THIS REPORT SHOWS ESTIMATED TIME THAT FUTURE WORK WILL BE PERFORMED. THESE TIMES WILL BE REVISED AS CONDITIONS DICTATE.
CORNER FIRED BURNER DEVELOPMENT FOR COAL/WATER FUEL
PROJECT:
JOB: 667-301-4900
PROJECT MANAGER: D.H. BERRIE
SHT. 1 of 1